



FUEL CELL TECHNOLOGY NEWS

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WHO'S WHO IN FUEL CELLS

QuantumSphere Nano-Nickel Tests Positive for SOFC Cathodes

We talked to Kevin Maloney, CEO, and Douglas Carpenter, Chief Scientific Officer and Director of R&D, the co-founders of QuantumSphere, Inc. This startup company built a reactor for the production of nano-materials. The first product, nano-nickel spheres, has proven to be an effective and low-cost alternative to platinum as a fuel cell catalyst.

FCTN: You have built a reactor for producing nano-nickel. What happens inside the reactor?

Carpenter: The reactor itself is about 17 feet tall. In it, we boil the metal and then recondense it under controlled conditions to reach a precisely controlled size. It forms nano-spherules of nickel with 10 nanometers and a high degree of uniformity. The process is the key.

FCTN: How are the nanoparticles used for catalyst in a fuel cell?

Carpenter: The particles, when seen on the macroscale, are a powder. We mix the nano particles with micron size particles, heat it to close to melting and cool it in a flow of argon. The heating temperature is less than half the melting temperature. The material is then pressed cold to less than 50% density.

FCTN: How is this used to replace platinum?

Carpenter: At the nano-scale, nano-nickel behaves much more like platinum than it does nickel. The kinetics of the material change dramatically on the nano-scale. It is as if we have found an entirely new periodic table.

FCTN: Is the nano-nickel as efficient as platinum when used as a catalyst?

Carpenter: It is a little less efficient than platinum, but because

it is porous, the nano-particles fill the pores and so the nano-nickel is at least as effective as platinum, at a cost of about 50% that of platinum. We control the pore size directly when we control the diameter of the nano-particles.

FCTN: Have you encountered any problems due to the high temperature experienced in SOFCs?

Carpenter: None, except for problems with the SOFCs themselves. Two of the test SOFCs experienced seal problems.

FCTN: Does this have any impact SOFC applications?

Maloney: As you know, current SOFCs must run at one speed. Thermal cycling to do load following can crack the electrodes. Because thermal cycling doesn't affect the nano-nickel catalysts, it raises the possibility of using SOFCs in portable FC applications.

FCTN: How are you applying this technology to PEM electrode assemblies?

Carpenter: We use sonic energy to disperse the particles in an ink fluid, directly replacing platinum. The nano-nickel replaces both the platinum and the carbon in the membrane electrode assemblies. Our first PEM electrodes are now being tested by several MEA manufacturers.

FCTN: How do the results of your process compare with what can be obtained from ion beam or vapor deposition processes?

Carpenter: The run rates are dramatically higher than anything that can be accomplished with the deposition processes.

FCTN: It would seem that this technology has other applications. What are you looking at in the short term?

Maloney: First the platinum catalyst replacements, then water hydrolysis, biosensors and filtration.

FCTN: Where do you see your operation evolving over the next decade?

Maloney: All these materials we are inventing will be commoditized within 7 to 10 years. We are filing our patents right now and exploring various relationships with major manufacturers.

FCTN: Is your process readily scalable to industrial production?

Capenter: We can increase production simply by adding more heating elements. In fact, the reactor runs more efficiently with more heating elements. The reactor itself is a modular design, so it is relatively easy to scale up to whatever quantity of output is needed.

FCTN: Would the same hold true for hydrolysis? I ask this because of the well-reported decline in fresh water supplies globally.

Maloney: Hydrolysis machinery that uses this technology can be scaled exponentially. As this application is developed, it will directly compete with existing electrolysis technologies. As for hydrogen production, the technology is more cost-effective than steam reforming of methane.